

What is claimed is:

1. A substrate processing system comprising:
 - an ozone generator provided with electrodes and configured to generate an ozone-containing gas by applying an electric discharge produced by the electrodes to an oxygen-containing gas supplied to the ozone generator;
 - a plurality of processing chambers each adapted to process therein a substrate with the ozone-containing gas generated by the ozone generator;
 - a plurality of ozone-containing gas supply lines each connecting the ozone generator to each of the processing chambers;
 - a flow regulator adapted to regulate a flow rate of the oxygen-containing gas supplied to the ozone generator; and
 - a controller configured to determine an ozone-containing gas demand of processes to be carried out in the processing chambers, and configured to control the flow regulator to regulate a flow rate of the oxygen-containing gas being supplied to the ozone generator so that a flow rate of the ozone-containing gas being discharged from the ozone generator to be supplied to the processing chamber or chambers complies with the ozone-containing gas demand.
2. The substrate processing system according to claim 1 further comprising a plurality of variable throttles each provided in each of the ozone-containing gas supply lines to adjust an ozone-containing gas distribution ratio between the ozone-containing gas supply lines.
3. The substrate processing system according to claim 2 further comprising a plurality of flow measuring devices each provided respectively in the ozone-containing gas supply lines for measuring respective flow rates of the ozone-containing gas flowing into the processing chambers.

4. The substrate processing system according to claim 1, wherein, the oxygen-containing gas contains oxygen gas and nitrogen gas, and wherein the flow regulator includes an oxygen gas flow regulating device adapted to regulate a flow rate of the oxygen gas supplied to the ozone generator and a nitrogen gas flow regulating device adapted to regulate a flow rate of the nitrogen gas supplied to the ozone generator.

5. The substrate processing system according to claim 4, wherein the oxygen-containing gas further includes carbon dioxide gas, and wherein the flow regulator further includes a carbon dioxide gas flow regulating device adapted to regulate a flow rate of the carbon dioxide gas supplied to the ozone generator.

6. The substrate processing system according to claim 1, further comprising:

- a power regulator adapted to regulate a voltage applied across the electrodes of the ozone generator; and

- an ozone concentration measuring device that measures an ozone concentration of the ozone-containing gas generated by the ozone generator,

- wherein the controller is also configured to control the power regulator to regulate the voltage being applied across the electrodes so that an ozone concentration of the ozone-containing gas being measured by the measuring device coincides with a target value.

7. The substrate processing system according to claim 1 further comprising:

- a steam generator adapted to generate a water vapor; and

- a plurality of steam supply lines each adapted to supply the water vapor to each of the processing chambers via each of the ozone-containing gas supply lines.

8. The substrate processing system according to claim 7 further comprising:

a steam discharge line connected to the steam generator and adapted to discharge therethrough a part of the water vapor generated by the steam generator without supplying it to the processing chambers; and

a flow control device provided in the steam discharge line to regulate a flow rate of the water vapor discharged through the steam discharge line,

wherein the controller is also configured to determine an water vapor demand of processes to be carried out in the processing chambers, and configured to control the flow control device to regulate the flow rate of the water vapor being discharged through the steam discharge line so that a sum of flow rates of the water vapor being supplied to the processing chamber or chambers complies with the water vapor demand.

9. The substrate processing system according to claim 1 further comprising:

an additional ozone generator provided with electrodes and configured to generate an ozone-containing gas by applying an electric discharge produced by the electrodes of the additional ozone generator to an oxygen-containing gas supplied to the additional ozone generator; and

a valve adapted to stop supplying the oxygen-containing gas into the additional ozone generator,

wherein the controller is also configured to control the valve to stop supplying the oxygen-containing gas into the additional ozone generator in order to stop generating the ozone-containing gas by the additional ozone generator, when the ozone-containing gas demand is less than a predetermined value.

10. The system according to claim 1 further comprising a plurality of processing fluid discharge lines connected

respectively to the processing chambers to discharge a processing fluid therefrom, each of the processing fluid discharge lines being provided therein with a flow control device.

11. A substrate processing system comprising:

- an ozone generator provided with electrodes and configured to generate an ozone-containing gas by applying an electric discharge produced by the electrodes to an oxygen-containing gas supplied to the ozone generator;

- a plurality of processing chambers each adapted to process therein a substrate with the ozone-containing gas generated by the ozone generator;

- a plurality of ozone-containing gas supply lines each connecting the ozone generator to each of the processing chambers;

- a plurality of blow-off lines, connected to each of the ozone-containing gas supply lines, adapted to discharge the ozone-containing gas from each of the ozone supply lines before the ozone-containing gas reaches each of the processing chambers; and

- a plurality of valves each adapted to connect or disconnect each of the blow-off lines to or from each of the ozone-containing gas supply lines.

12. The substrate processing system according to claim 11 further comprising a controller configured to determine whether or not a process to be carried out in each of the processing chamber requires the ozone-containing gas, and configured to control each of the valves to connect or disconnect each of the blow-off lines to or from each of the ozone-containing gas supply lines so that the ozone-containing gas is being supplied only to the processing chamber or chambers that are requiring the ozone-containing gas.

13. The substrate processing system according to claim 11,

further comprising a plurality of variable throttles each provided in each of the ozone-containing gas supply lines and the blow-off lines to adjust an ozone-containing gas distribution ratio between the ozone-containing gas supply lines and the blow-off lines.

14. The substrate processing system according to claim 13 further comprising:

a plurality of flow measuring devices provided respectively in the ozone-containing gas supply lines for measuring respective flow rates of the ozone-containing gas flowing into the processing chambers; and

a plurality of flow measuring devices provided respectively in the blow-off lines for measuring respective flow rates of the ozone-containing gas flowing through the blow-off lines.

15. The substrate processing system according to claim 12 further comprising:

a steam generator adapted to generate a water vapor; and

a plurality of steam supply lines that supply the water vapor to each of the processing chambers via each of the ozone-containing gas supply lines.

16. A substrate processing system comprising:

a plurality of first gas passages;

a plurality of ozone generators each interposed in each of the first gas passages, each of the ozone generators being provided with electrodes and configured to generate an ozone-containing gas by applying an electric discharge produced by the electrodes to an oxygen-containing gas fed from an upstream side of each of the first gas passages to each of the ozone generator in order to discharge the ozone-containing gas therefrom toward a downstream side of each of the first gas passages;

a second gas passage connected to the first gas passages ;
a plurality of processing chambers each adapted to process therein a substrate with the ozone-containing gas generated by the ozone generators ;

a plurality of third gas passages branched from the second gas passage and connected respectively to the processing chambers to supply the ozone-containing gas to the processing chambers ; and

a controller configured to determine an ozone-containing gas demand of processes to be carried out in the processing chambers , and configured to control a state of at least one of the ozone generators between a first state in which said at least one of the ozone generators is generating the ozone-containing gas and a second state in which said at least one of the ozone generator stops generating the ozone-containing gas so that a sum of flow rates being discharged from the ozone generators toward the downstream sides of the first gas passages complies with the ozone gas demand.

17. The substrate processing system according to claim 16, wherein:

at least one of the first gas passages corresponding to said at least one of the ozone generators is provided therein with a valve adapted to open and close said at least one of the first gas passages ;

the controller is also configured to close said at least one of the first gas passages by closing the valve placed in said one of the first gas passages when said at least one of the ozone generators is in the second state.

18. The substrate processing system according to claim 16, wherein the plurality of first gas passages are configured to be supplied with oxygen-containing gas from a common oxygen-containing gas source.

19. A substrate processing method comprising the steps of:
providing a processing system including an ozone generator having electrodes, and a plurality of processing chambers each adapted to process a substrate therein by using an ozone-containing gas generated by the ozone generator;
determining an ozone-containing gas demand of processes to be carried out in the processing chambers;

feeding an oxygen-containing gas to the ozone generator at a flow rate that enables the ozone generator to discharge an ozone-containing gas at a flow rate that complies with the ozone-containing gas demand;

applying a voltage across the electrodes of the ozone generator to produce an electric discharge, thereby producing an ozone-containing gas by applying the electric discharge to the oxygen-containing gas fed to the ozone generator;

supplying the ozone-containing gas thus generated by the ozone generator and discharged therefrom to the processing chamber or chambers, thereby processing a substrate accommodated in each of the processing chamber or chambers with the ozone-containing gas; and

changing the flow rate of the oxygen-containing gas being fed to the ozone generator, if the ozone-containing gas demand changes.

20. The method according to claim 19 further comprising the steps of;

measuring an ozone concentration of the ozone containing gas generated by the ozone generator; and

controlling the voltage applied across the electrodes based on the measured ozone concentration so that the ozone concentration is coincide with a target value.

21. A substrate processing method comprising the steps of:
providing a processing system including an ozone generator having electrodes, and a plurality of processing chambers each adapted to process a substrate therein by using

an ozone-containing gas supplied by the ozone generator;
determining whether or not each of the processing chambers requires the ozone-containing gas;
feeding an oxygen-containing gas to the ozone generator;
applying a voltage across the electrodes of the ozone generator to produce an electric discharge, thereby producing an ozone-containing gas by applying the electric discharge to the oxygen-containing gas fed to the ozone generator;
supplying the ozone-containing gas thus generated by the ozone generator only to the chamber or chambers that are requiring the ozone-containing gas, thereby processing a substrate accommodated in each of the processing chamber or chambers with the ozone-containing gas; and
discarding a part of the ozone-containing gas generated by the ozone generator without supplying it to any one of the processing chambers.

22. The method according to claim 21, wherein:

the processing system further includes a plurality of ozone-containing gas supply lines each connecting the ozone generator to each of the processing chambers, and a plurality of blow-off lines each adapted to connect to each of the ozone-containing gas supply lines to discard the ozone-containing gas from each of the ozone-containing gas supply lines; and

the discarding step is carried out by connecting the blow-off line or lines to the ozone-containing gas supply line or lines corresponding to the chamber or chambers that are not requiring the ozone-containing gas.

23. A substrate processing method comprising the steps of:
providing a processing system including a plurality of ozone generators each having electrodes, and a plurality of processing chambers each adapted to process a substrate therein by using an ozone-containing gas supplied by the ozone generator;

determining an ozone-containing gas demand of processes to be carried out in the processing chambers;

determining the number of the ozone generators to be operated to generate an ozone-containing gas based on the ozone-containing gas demand;

feeding an oxygen-containing gas to the ozone generator or generators determined to be operated;

applying a voltage across the electrodes of the ozone generator or generators determined to be operated to produce an electric discharge, thereby producing an ozone-containing gas by applying the electric discharge to the oxygen-containing gas fed to the ozone generator or generators;

supplying the ozone-containing gas thus generated by the ozone generator or generators to the processing chamber or chambers, thereby processing a substrate accommodated in each of the processing chamber or chambers with the ozone-containing gas;

changing the number of the ozone generators to be operated, if the ozone-containing gas demand is increased or decreased.